

EFFECTS OF CORN FLAKE WEIGHT ON NUTRIENT INTAKE AND RETENTION BY FINISHING HEIFERS

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ABSTRACT: Eight Charolais-cross heifers (359 ± 28 kg) were used in a two period crossover design experiment to determine the impact of corn flake weight on nutrient intake and retention. Heifers were randomly assigned to one of two 85% concentrate diets (79% steam flaked corn, 15% alfalfa hay, 3.0% molasses/fat blend, 0.5% urea, and 2.5% supplement) with corn steam-flaked at either 1) 322 g/L (25 lb/bu; SF25) or 2) 387 g/L (30 lb/bu; SF30). Dietary treatments were fed ad libitum to individually penned heifers. Each period lasted 14 d; 9 d for adaptation to dietary treatments and 5 d for daily collections of feed samples, feed refusals, and total fecal and urine output (using fecal bags). Rectal grab samples of feces were collected daily at 5 h after feeding to determine fecal pH. Daily fecal and urine output were mixed thoroughly and 5% aliquot retained and frozen for subsequent analysis. Feed, feed refusals, and fecal plus urine samples were composited for each heifer by period and analyzed for DM, OM, NDF, and N. Intakes of DM (7.72 and 8.64 ± 0.11 kg for SF25 and SF30), OM (7.26 and 8.09 ± 0.10 kg for SF25 and SF30), NDF (1.89 and 2.06 ± 0.03 kg for SF25 and SF30), and CP (1.02 and 1.19 ± 0.02 kg for SF25 and SF30) decreased ($P < 0.01$) with lighter flake weight corn (SF25). Retention of DM (76.1 and $77.8 \pm 1.0\%$ for SF25 and SF30), OM (81.1 and $81.8 \pm 1.0\%$ for SF25 and SF30), and NDF (54.9 and $58.3 \pm 2.4\%$ for SF25 and SF30) were not affected ($P > 0.2$) by level of corn processing, but CP retention (48.2 and $52.9 \pm 2.1\%$ for SF25 and SF30) tended ($P = 0.15$) to be greater for SF30 than SF25. Fecal pH (6.48 and 6.40 ± 0.04 for SF25 and SF30) was not affected ($P > 0.05$) by treatments. Results suggest that greater degree of corn steam-flaking decreases dietary intakes but does not affect nutrient retention and fecal pH of heifers fed an 85% concentrate diet.

Key Words: Heifers, Steam-flaked corn, Nutrient Retention)

Introduction

Corn grain is used extensively in beef cattle finishing diets as a major source of energy, and steam-flaking is one of the most important tools used by the cattle feeding industry to improve the efficiency of energy utilization. Steam-flaking causes starch to gelatinize and improves starch availability and digestion. Also, the extent of starch availability increases with a greater degree of steam-flaking (Ronney and Pflugfelder, 1986; Zinn, 1990a, 1990b). Zinn et al. (1995) demonstrated that

steam-flaking of corn increases the digestion of starch over the dry-rolled corn, and Brown et al. (2000) found that increasing steam-flaking corn from 360 g/L to 260 g/L improved feed efficiency. However, extensive processing of corn may also predispose cattle to acidosis and affect feed intake and nutrient utilization by cattle (Yu et al., 1998). Therefore, the objective of this study was to evaluate the effect of corn flake weight on nutrient intake and retention.

Materials and Methods

Experimental protocols were approved by the New Mexico State University Institutional Animal Care and Use Committee. Eight Charolais-cross heifers (359 ± 28 kg) were randomly assigned to one of two 85% concentrate diets (Table 1) with corn steam-flaked at either 1) 322 g/L (25 lb/bu; SF25) or 2) 387 g/L (30 lb/bu; SF30). Dietary treatments were fed ad libitum once a day (0900) to individually penned heifers, which were implanted with estradiol/trenbolone acetate (Revalor-H, Intervet, Millsboro, DE) at the beginning of the experiment.

Heifers were stepped up from a 50% concentrate diet to the 85% concentrate finishing diet (Table 1) over a 15-d period. Feed bunks were managed to allow no more than 250 g of feed per heifer to remain 1 h prior to feeding.

The experiment was a crossover design with two 14 d periods; 9 d for adaptation and 5 d for collections. Feed samples were collected on d 9 through d 13 and feed refusals were collected on d 10 through d 14, weighed, composited for each heifer, and a representative sample saved for nutrient analysis. Heifers were fitted with fecal bags on d 10 and total feces and urine were collected and weighed daily for 5 d in order to measure N retention. Fecal and urine bags were emptied twice a day, and collections of feces and urine were mixed thoroughly and a 5% aliquot retained and frozen. Fecal and urine samples were later composited for each heifer, thoroughly mixed, and a representative sample of this mixture was frozen at -20 °C for subsequent analyses. Ammonia loss from fecal and urine samples was prevented by addition of 6 N HCl (50 mL). In addition, fecal grab samples were obtained from each heifer at 5 h after feeding on d 10 through d 14 of each period for determination of fecal pH. Feed samples, feed refusals, and fecal plus urine samples were dried at 55 °C in a forced-air oven, ground (Wiley mill, 2.0-mm screen) and analyzed for DM (100 °C for 24 h),

OM (500 °C for 8 h), NDF (Ankom 200 fiber analyzer, Ankom Technology Cooperation, Fairport, NY), and N (LECO Nitrogen Analyzer, model FP-528, LECO Corporation, St. Joseph, MI). Data were analyzed using GLM procedures of SAS (Statistical Analysis System, SAS Inst. Inc., Cary, NC).

Results and Discussion

Intake and retention of DM, OM, NDF, and CP are listed in Table 2. Intakes of DM, OM, NDF, and CP decreased ($P < 0.01$) by 8 to 14% for heifers fed corn that was flaked to a lighter weight (SF25). The decline in feed intake is consistent with Brown et al. (2000) who found a decline in DM intake with increasing degree of corn processing. However, Zinn (1990a) found no differences in DM intake with increased corn processing (410, 360, and 300 g/L). Decreased feed intake in response to a greater degree of steam-flaking of corn is likely due to rapid fermentation rates of starch in the rumen (Zinn, 1990a; Brown et al., 2000; Zinn, et al., 2000) and greater caloric availability per unit of feed. Because excretion of DM, OM, NDF, and CP was not affected ($P > 0.2$) by flake weight, more ($P < 0.05$) DM, OM, NDF, and CP was retained for SF30 vs SF25. However, retention expressed as a percentage of intake for DM, OM, and NDF was not affected ($P > 0.2$) by level of corn processing, while CP retention tended ($P = 0.15$) to be greater for SF30 than SF25. Yu et al. (1998) found that the digestibility of OM and CP were similar between corn flaked at 309 g/L vs 361 g/L; however, the digestibility of NDF was greater in 361 g/L flake weight than for 309 g/L. Authors indicated that a subacute acidosis might have caused a decline in NDF digestibility for cattle fed lighter flaked weight corn. Zinn (1990a) observed a decrease in the digestibility of OM and N with increasing flake density.

Fecal pH was similar ($P > 0.05$) between SF25 and SF30. Steam-flaking corn generally increases fecal pH (Barajas and Zinn, 1998; Lee et al., 1982) because of increased ruminal starch digestion and decreases the amount of starch that reaches the large intestine (Zinn et al., 2002).

Implications

Knowledge of the effect of different flake weight corn may be a useful tool in predicting the performance and productivity of finishing beef cattle fed high concentrate diets. Results from this experiment suggest that greater degree of corn steam-flaking decreases dietary intakes but does not affect nutrient retention and fecal pH of heifers fed an 85% concentrate diet.

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Table 1. Diet composition

Item	% of DM
Ingredient	
Corn, steam-flaked ^a	79.0
Alfalfa hay	15.0
Molasses/fat blend	3.0
Supplement	2.5
Urea	0.5
Nutrient	
OM	93.5
NDF	24.0
CP	13.7
Ca ^b	0.73
P ^b	0.28

^aCorn was steam-flaked at either 322 g/L (25 lb/bu; SF25) or 387 g/L (30 lb/bu; SF30).

^bCalculated from NRC tabular values.

Table 2. Effects of flake weight corn on nutrient intakes and retention by finishing heifers

Item	Treatment ^a		SE ^b	P-value
	SF25	SF30		
Intake, kg/d				
DM	7.72	8.64	0.11	< 0.01
OM	7.26	8.09	0.10	< 0.01
NDF	1.89	2.06	0.03	< 0.01
CP	1.02	1.19	0.02	< 0.01
Excretion, kg/d				
DM	1.85	1.91	0.06	0.50
OM	1.38	1.47	0.06	0.32
NDF	0.86	0.83	0.04	0.60
CP	0.53	0.56	0.02	0.23
Retained, kg/d				
DM	5.87	6.73	0.15	< 0.01
OM	5.88	6.62	0.14	< 0.01
NDF	1.03	1.23	0.06	0.05
CP	0.49	0.63	0.03	0.02
Retention, % of intake				
DM	76.1	77.8	1.0	0.28
OM	81.1	81.8	1.0	0.60
NDF	54.9	58.3	2.4	0.36
CP	48.2	52.9	2.1	0.15
Fecal pH	6.48	6.40	0.04	0.21

^aSF25 = Corn steam-flaked at 322 g/L (25 lb/bu); SF30 = corn steam-flaked at 387 g/L (30 lb/bu).

^bStandard error of least squares means.